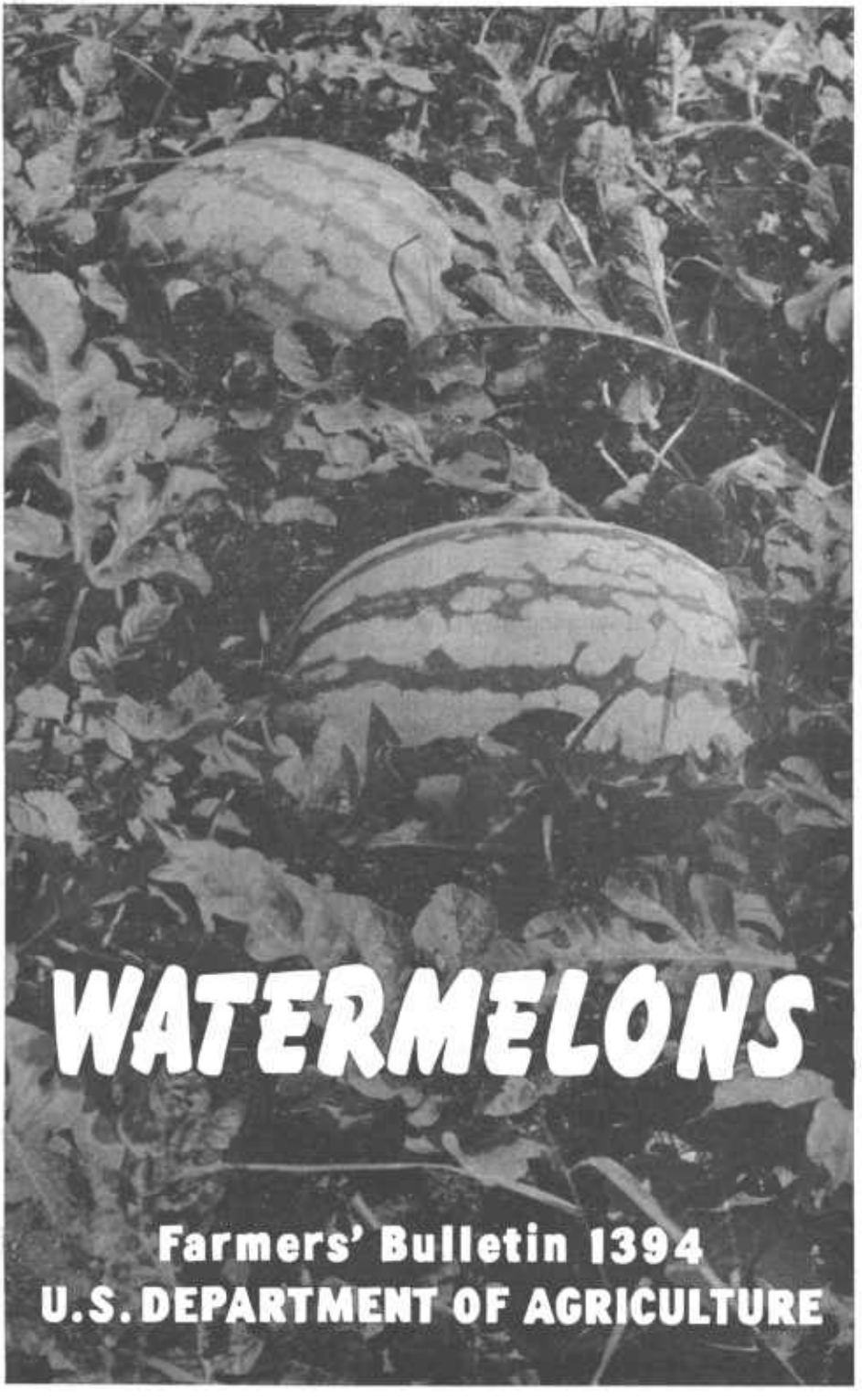

WATERMELONS

Farmers' Bulletin 1394
U.S. DEPARTMENT OF AGRICULTURE

WATERMELONS are grown widely as a market crop in the United States. Sections noted for their heavy watermelon production include parts of Georgia, Florida, South Carolina, Texas, Oklahoma, Missouri, and California. The area planted to this crop in the 23 principal producing States in 1948 was reported by the Bureau of Agricultural Economics as 255,490 acres. Commercial production in the 23 States in the 10 years 1937–46, according to the Bureau's figures, averaged 67,000,000 melons a year.

Prevailingly, watermelons are grown as a part of a regular crop rotation. In many sections they are useful as a catch crop—one that can be used where a staple crop has failed or that can be grown profitably where timber has recently been cut and the land is being put into condition for other crops.

A yield of 350 to 400 marketable watermelons per acre is good but not exceptional. A 32- to 34-pound melon, which loads 800 to 1,000 to a car, is considered standard, although melons weighing as little as 18 pounds and loading 1,600 to a car are shipped. Yields of 4 to 5 tons per acre are common.

This bulletin describes leading watermelon varieties in such a way as to help the grower select those best fitted to his needs and outlines tested methods of growing the melons, protecting them from disease and insect losses, and harvesting the crop.

Washington, D. C.

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Watermelons[1]

By J. H. BEATTIE, *senior horticulturist*, and S. P. DOOLITTLE, *senior pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration*

Contents

WATERMELONS are an uncertain and perishable crop, grown and marketed at more than average risk. Much loss results from overproduction and from unfavorable weather during the growing season. Weather during the marketing season, also, can greatly affect the profits from this crop. On clear, hot days in spring, summer, and fall, watermelons sell fast; but whenever the weather turns cool and wet they lose much of their appeal. Often serious losses are caused by diseases that originate in the growing plants and develop in melons on the way to market. Under present conditions it would be unwise to make any decided increase in the acreage used to grow the melons for shipment. Farmers could do much, however, toward improving their methods of growing watermelons and thus increasing both yield and quality of the crop.

Watermelon shipments from southern Florida and southern Texas begin in April, and the season gradually moves northward. In the most northern of the watermelon-producing States the crop goes on the market about October 1. When the northern crop is gone, California and Colorado continue to supply special varieties known as winter watermelons. These are available in limited supply until Christmas.

[1] Earlier editions of this bulletin were written by W. R. Beattie, formerly senior horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.

SUITABLE SOIL TYPES

Rich, sandy loam soils rate as the best for watermelons, but almost any well-drained warm and fertile soil that can be worked in early spring is suitable for this crop. Throughout the South, watermelons are often the first field crop grown on land that has been cleared of timber. The soil of recently deforested land contains much decayed vegetable matter, and plants growing on it withstand dry weather better than those growing on land that has been cropped for several years. Newly cleared land has the advantage, also, of not being infested with disease organisms that may seriously affect the watermelon crop. Some of the heaviest yields are produced on the sandy river-bottom or delta soils of southeastern Missouri and on similar soils elsewhere.

The soil of the typical rolling sandy watermelon field is very likely to be infested with root knot nematodes, and in selecting a field the grower should carefully investigate its condition in this respect.

CROP ROTATION

From the standpoint of disease control, once in 6 years is as often as watermelons should be grown on any piece of land and once in 8 or 10 years is preferable. This applies particularly to areas where control of root knot nematodes is a problem.

The crops most commonly rotated with watermelons in the South are corn and cowpeas, velvetbeans, cotton, winter oats, and peanuts; in the North they are corn, wheat, and clover or other pasture. A crop of velvetbeans or clover turned under during the summer and allowed to decay forms an excellent supply of soil organic matter to nourish watermelons grown the next year. In Florida and southern Georgia the watermelon crop is harvested in ample time for planting velvetbeans or cowpeas the same season.

PREPARING AND FERTILIZING THE SOIL

Although watermelons do not require much cultivation, the soil must be well plowed and harrowed before they are planted. On newly cleared forest land most of the sticks, roots, and trash at the surface that would interfere with cultivation should be removed or burned, both before and after plowing. Small roots, which are brought to the surface in quantities during the final preparation of the soil, should be piled around the stumps and either used for some such purpose as filling gullies or burned. On old land, especially if it is in sod or has on it some such crop as velvetbeans, cowpeas, or clover, plowing should be done either in the fall or at some time during the winter when the ground is in suitable condition. Early in the spring the soil should be thoroughly disked and harrowed or dragged in preparation for planting. The same general preparation required for corn or cotton fits the soil for watermelons.

While it is necessary to have the land in good condition, the melon grower should avoid the mistake of overexpensive preparation. The work should be done with simple tools and by economical methods.

Barn or feed-lot manure free of the fungus causing wilt of watermelons may be used as a fertilizer at the rate of 4 to 6 tons per acre. The wilt fungus grows readily in stable manure, and a common cause of infection is feeding hay that contains diseased watermelon vines cut from fields after the melons were harvested. Where wilt is prevalent, growers are advised to use extreme care to prevent the manure supply from becoming infested, and to depend mainly upon soil-building crops and commercial fertilizers as sources of plant nutrients. Any manure used should first have rotted fairly well, and should be mixed thoroughly with the soil.

The best method of distributing manure depends on how much is available and how the watermelon seed is going to be planted. If the manure available does not amount to more than 3 or 4 tons per acre and the seed is to be planted in hills, the manure should be worked into the hills. Where the crop is to be grown in continuous rows the manure is scattered in a furrow and a double furrow is thrown over it, forming a slight bed, or elevation, on which the seed is planted. If manure is available in a greater quantity per acre it should be broadcast or scattered in a strip along the row and thoroughly disked into the soil. Even a small quantity of manure worked into the hills or furrows is decidedly helpful in producing strong early growth—provided the manure is free of the wilt fungus.

Chemical fertilizers are usually indispensable in producing large acreages of watermelons. Florida growers commonly use 1,200 pounds of fertilizer per acre, applying it in a strip along the row by hand or with a fertilizer distributor. Either of two mixtures is commonly used, one containing 4 percent of nitrogen, 7 percent of phosphoric acid, and 5 percent of potash and one containing 3 percent of nitrogen, 8 percent of phosphoric acid, and 8 percent of potash. In addition melons may be side dressed once or twice with nitrate of soda or other nitrogen salts at a rate of 100 to 150 pounds per acre.

In Georgia, growers apply about 800 pounds per acre of fertilizer usually containing about 4 percent of nitrogen, 8 percent of phosphoric acid, and 4 percent of potash and supplement this with a side dressing of about 150 pounds of 10–0–10 or 10–0–14 fertilizer per acre.

In the Southwest most watermelon growers use a 5–10–5 mixture at rates of 200 to 400 pounds per acre. Some, especially where soils are fertile and moisture supplies are scanty, use no fertilizer. Many growers side dress the plants with ammonium nitrate when the vines are about 18 inches long. A few apply an additional side dressing when the first blooms appear.

Virginia growers ordinarily use 500 to 800 pounds of 5–10–5 fertilizer before planting, and side dress with 200 to 300 pounds of a fertilizer such as sodium nitrate or ammonium sulfate when the runners start.

In Missouri, southern Illinois, and some other melon-shipping sections, watermelon growers as a rule apply not less than 200 pounds nor more than 800 pounds of a well-balanced mixture. Many of them put a little extra fertilizer directly into the hills and mix this thoroughly with the soil to give the plants a good

send-off. Others carefully apply a pinch of nitrate of soda near the plants in each hill just after the plants come up.

It would seem that growers in sections where a complete fertilizer is required might save something in freight bills by using higher-grade fertilizer mixtures, in proportionately smaller quantities. The fillers used in lower-grade fertilizer mixtures, which add no plant nutrients to them, are used in much smaller quantities or not at all in the higher-grade mixtures. A fertilizer containing 5 percent of nitrogen, 10 percent of phosphoric acid, and 5 percent of potash contains practically no filler, and 640 pounds of this mixture has the same quantity of plant nutrients as 800 pounds of a mixture containing 4 percent of nitrogen, 8 percent of phosphoric acid, and 4 percent of potash.

DESIRABLE VARIETIES

In the past, watermelon growers who planned to ship their produce chose varieties from which they could expect heavy yields of melons averaging 35 to 45 pounds in weight, uniform in size and shape, and having firm red flesh and a heavy or tough rind that would withstand handling. Recently, consumer demand for better quality has caused growers to seek varieties having tender, crisp, sweet flesh, few seeds, little fiber, and no water cores. Plant breeders have succeeded in developing varieties that have all these desired characteristics and a thin rind that is firm enough to stand shipment. Also, they have produced some varieties that have resistance to the wilt disease. Brief descriptions of desirable varieties are offered here as a guide in selecting varieties to grow for shipping, local marketing, and home use. Further information on varieties best adapted to particular localities may be obtained from county agricultural agents and from local growers.

Angeleno, White-seeded and Black-seeded.—Fruit nearly round, weighing on an average about 20 pounds. Rind thin, dark green with a tinge of gold showing through, so firm that it rarely breaks in shipping. Flesh bright red, free of fiber.

Blacklee.—Rather new variety highly resistant to fusarium wilt. A hybrid of Leesburg and Hawkesbury, two resistant sorts. Produced by M. N. Walker, of the Florida Agricultural Experiment Station. Appears to be one of the best wilt-resistant watermelons thus far developed. Fruit long to oval, smooth, symmetrical, weighing 30 to 40 pounds. Rind dark green, liable to sunburn, tough, withstands long hauls and rough handling. Flesh red, seed black. Appearance of cut melon very attractive.

Chilean, White-seeded and Black-seeded.—Fruit weighs on an average about 18 pounds. Rind thin, dark green with distinct stripes and with a tinge of yellow showing through. Flesh bright red, sweet, free of fiber. Prolific. Suitable for local marketing.

Citron (Preserving Melon).—Fruit remains solid and flesh almost unchanged in color at maturity. Two varieties, small round and large green. Small round usually weighs about 10 pounds or less. It is used for making preserves and pickle. Large green frequently grows to a length of 30 inches and weighs 30 to 60 pounds, and is commonly used as a stock feed. In mild climates it can be left in the field until used.

Congo.—New variety possessing considerable resistance to anthracnose. Developed at the United States Department of Agriculture's Regional Vegetable Breeding Laboratory, Charleston, S. C. Fruit oblong, blocky, ordinarily weighing 30 to 35 pounds but often much heavier, dark green with faint stripes of lighter green. Rind tough and firm, resists breakage in transit. Quality similar to that of Garrison. Variety now attracting widespread attention, especially throughout Southeast.

Dixie Queen.—Fruit round or slightly oval, with blunt ends, weighing about 25 to 30 pounds. Rind thin, tough, light green with dark-green stripes. Stripes not so clearly outlined as to give a ribbed appearance. Flesh rich scarlet, fine-grained, tender, excellent in flavor. Seed small, white, usually very few. Yield good. Shipping quality good. Excellent for delivery by truck to nearby markets.

Early Kansas.—Fruit round or slightly oval, sometimes weighing 80 pounds. Rind thin, light green with broad, irregular dark-green stripes. Flesh deep red, fine in texture and flavor. Seed red at first, buff when melon has ripened. Exceptionally vigorous grower, producing heavy crops on good soil. A good shipper.

Excel.—Fruit long, often weighing 60 pounds. Rind thin, tough, elastic, dark green with mottled stripes of light green. Flesh deep red. Seed black. A good shipper, extensively grown in sections having a long growing season.

Florida Favorite.—Fruit oval to long, weighing on an average about 25 pounds. Rind fairly tough, dark green with lighter green stripes. Flesh deep red, of high quality, very sweet. Seed white. Early-maturing variety, excellent for home use or local marketing and fair for shipping.

Florida Giant (known also as **Cannonball, Black Diamond,** and **Texas Giant**). —Fruit round or slightly oval, often weighing 50 pounds, attractive in appearance. Rind dark green, thick, firm. Flesh rather coarse-grained and fibrous, deep red, sweet. Seed small, black. Growth vigorous. Excellent shipper, and of fairly good eating quality.

Garrison (known also as **Coker** and **Darlington**).—Fruit cylindrical, often weighing 50 pounds. Rind very thin, tender, white with green broken stripes somewhat like those of Georgia Rattlesnake variety. Flesh brilliant red, almost free of fiber, very sweet, has pleasing aroma. Sometimes said to excel all other watermelons in quality. Tenderness of rind makes shipping impractical unless special precautions are taken in packing. Grown on about 16,000 acres in South Carolina in 1950. There, fruits often packed for shipment in layers separated by excelsior. Because of high quality, extremely desirable for home gardens.

Georgia Rattlesnake.—Fruit long, usually weighing about 30 pounds or more. Rind very tough, gray or yellowish green with green stripes. Flesh deep red, fine-grained, sweet. Seed white or creamy, with black or brown tips. A good shipper. Long a favorite in the South.

Golden Honey.—Fruit round, weighing about 25 pounds. Rind light green with mottled stripes. Flesh golden yellow or glistening amber yellow, tender, fine-flavored, free of hard centers or stringy sections. Seed brown.

Halbert Honey.—Fruit oblong to cylindrical, well-grown specimens weighing about 30 to 35 pounds. Rind thin, tender, dark green with fine veins. Flesh crimson, very tender, fine-textured and melting, superior in flavor, free of stringiness. Seed white with black tips. Similar to Kleckley Sweet, but undesirable for shipping because of tenderness of rind. An outstanding variety for home and market gardens.

Harris Early.—Fruit round or oval, weighing about 20 pounds. Rind brittle and thin, dark green with lighter green stripes. Flesh rich red, rather firm, fine-grained, sweet. Seed black. Early variety adapted to shorter season of northern sections, excellent for home gardens and local marketing.

Hawkesbury.—Wilt-resistant variety developed in New South Wales, Australia. Fruit about 18 inches long and 8 to 10 inches in diameter. Rind light gray with deeper green veining. Flesh deep pink, of medium quality. Largely used for shipping but now being displaced by the better-quality Blacklee.

Irish Grey.—Fruit (fig. 1) long, usually weighing 30 to 40 pounds. Rind yellowish gray with interwoven threadlike veins, smooth marblelike surface, practically no ribbing. Flesh bright red, firm, compact, free of hard centers and stringiness, sweet, not likely to break when sliced. Seed white. Fruit stands up well when shipped.

Kleckley Sweet.—Fruit (fig. 2) oval to long, usually weighing 20 to 25 pounds. Rind dark bluish green, too tender for long-distance hauling. Flesh red, of excellent quality. Seed white with occasional traces of brown. Variety one of best for home use and local marketing. **Improved Kleckley Sweet,** or

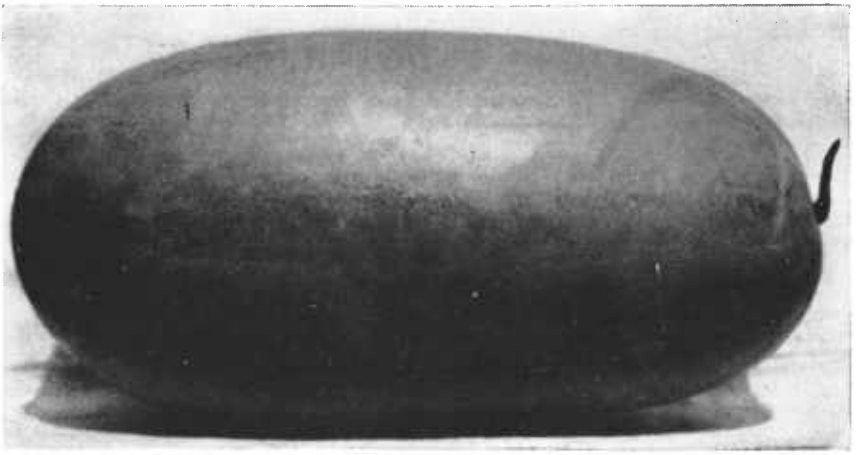

Figure 1.—Watermelon of the Irish Grey variety.

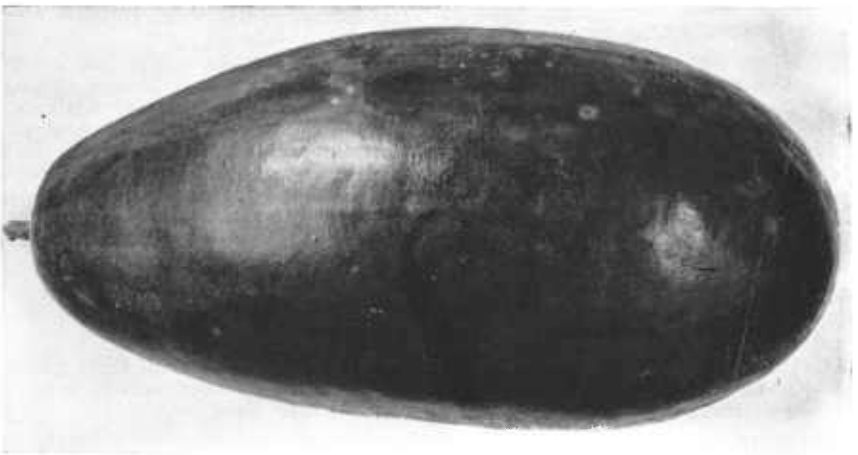

Figure 2.—Watermelon of the Kleckley Sweet variety.

Wondermelon.—Fruit oval to long, averaging about 30 pounds. Rind dark green, glossy, rather thin but fairly tough and capable of standing short-distance shipment or truck haul. Flesh bright scarlet, sweet, tender. Seed white. Very productive. **Improved Kleckley Sweet No. 6.**—Produced in 1936 by Iowa State Agricultural Experiment Station. Fruit oval to long, averaging about 30 pounds. Rind dark green, thin, tough, capable of standing short-distance shipment. Flesh red, crisp, tender. Good for general purposes. Fruit matures about 1 week later than that of earliest commercial strains of Kleckley Sweet. Wilt-resistant.

Klondike.—Fruit oblong to long, usually weighing 20 to 25 pounds, keeps well. Rind thin, tender, dark green, slightly ribbed; that of a selection known as Striped Klondike, light green with dark-green striping. Flesh deep scarlet, firm, excellent in quality. One strain with black seed, one with brown seed. Very popular in West. **Klondike R–7.**—Resistant to fusarium wilt. Fruit oblong, about 14 by 10 inches, weighing about 25 pounds. Rind thin but tough. Flesh solid deep red, with fine texture and high sugar content. Variety developed at the California Agricultural Experiment Station and popular in California.

Kolb Gem.—Fruit nearly round, weighing about 25 pounds. Rind thick, dark green with broad light stripes. Flesh medium red, very firm. Seed black. Fruit matures in about 90 days. A good shipper.

Leesburg.—Developed for wilt resistance from Kleckley Sweet variety by the Florida Agricultural Experiment Station in 1931–35. Fruit similar in many respects to that of parent variety but more blocky at the ends, uniform in shape, usually weighing 20 to 30 pounds but not infrequently going below that range or as high as 35 pounds. Rind smooth or faintly grooved, of a medium-dark, slightly bluish green color, thin to medium thick, hard and tough. Flesh deep rose pink, fine-textured, firm, extending well into the ends, clearly demarked from rind. Seed white. Well adapted to shipping. Objectionable features are a tendency to lateness and the color of the flesh, which is not so clear a red as that of a good strain of Tom Watson.

Northern Sweet.—Fruit smaller that that of Harris Early, nearly round, slightly flattened at ends. Rind green with dark-green striping, ½ to ⅝ inch thick, strong although rather brittle, withstands handling fairly well. Flesh of good quality, nearly free of stringiness. Seed about the size of those of Kleckley Sweet, smooth, yellowish brown when ripe. Variety early or second early, producing ripe melons in 9 to 10 weeks after planting. Developed by the Minnesota Agricultural Experiment Station.

Stone Mountain, or Dixie Belle.—Fruit (fig. 3) almost round, weighing about 30 pounds. Rind green, slightly ribbed, medium thick and fairly tough, making melon a good shipper. Flesh rich scarlet, tender, very sweet, free of white cores or stringiness, but inclined to crack when fruit becomes slightly overmature. Seed white with black tips.

Sweet Siberian.—Fruit about 9 by 9 inches, weighing about 10 pounds. Rind green. Flesh yellow, of very good quality. A quickly maturing variety, desirable for localities where the growing season is short.

Thurmond Grey.—Fruit long, oval, blunt at ends, usually weighing 30 to 40 pounds. Rind green gray, with interwoven thread-like veins, slightly ribbed, thin but tough, making melon a good shipper. Flesh red and free of stringiness. Seed brown.

Tom Watson.—Fruit (fig. 4) oval to long, weighing about 35 pounds. Rind dark green, tough, medium thick, with prominent ribbing. Flesh deep red, firm, slightly coarse in texture, fairly sweet. Seed brown-smeared, numerous. For many years the leading shipping variety in many watermelon-growing sections,

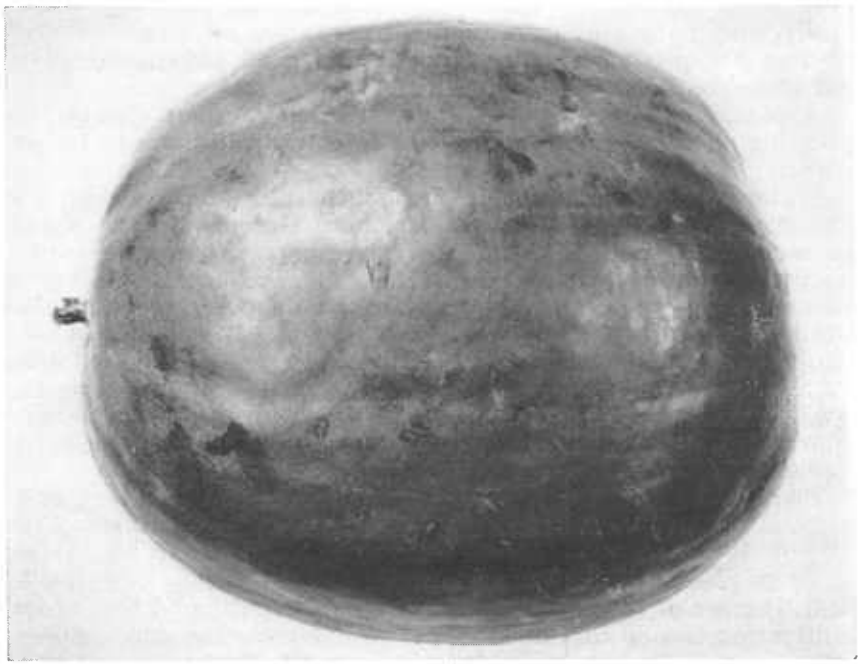

Figure 3.—Watermelon of the Stone Mountain, or Dixie Belle, variety.

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but gradually giving way to improved strains and varieties having better eating quality.

Winter King and **Winter Queen.**—Fruit only about 9½ by 9 inches, weighing about 14 pounds. Rind light cream with stripes of light green. Flesh fine-textured, sweet. If properly stored, fruit will keep for several months.

Yellow Ice Cream.—Fruit oblong, rather large. Rind deep green. Flesh bright golden yellow and very sweet, with rich, sugary flavor different from that of any other watermelon.

Figure 4.—Tom Watson watermelon.

PLANTING AND THINNING

Poor seed has been responsible for many of the failures and low yields of watermelon plantings. There is little excuse for using poor seed; high-grade watermelon seed can be produced rather easily, and many seed growers and dealers are offering such seed at fair prices. Growers are advised under all circumstances to get their seed from dependable sources.

A pound of good watermelon seed is more than enough for planting an acre. The small amount left over can be used for replanting if that becomes necessary.

Watermelon planting begins in southern Florida during late December or early January, in southern Georgia during March or early April, and in the northern commercial watermelon-producing sections within the period May 10–20. Because the young plants are easily injured by frost, the seed should not be planted until the soil has become warm and danger of frost is past. To avoid the possibility of crop loss from frost, many growers make an additional row planting 3 to 5 days after the first, setting the seed 3 or 4 inches away from those of the original planting. Sometimes when planted seed are injured by frost a third seeding is made to insure a stand.

Planting distances do not vary greatly among different commercial watermelon-producing localities. In the Southeast, the 10- by 10-foot spacing is perhaps the most popular but a few growers plant as closely as 8 by 10 feet or as widely as 10 by 12 feet. If rows of hills are placed 12 feet rather than 10 feet apart, cultivation can be continued longer in one direction and spraying with power sprayers can be done more easily. Texas growers, who get the largest average yield per acre, plant at distances averaging

12 by 12 feet. Many of them give the plants practically as much room by placing the hills 10 by 14 feet apart. Either of these arrangements means about 300 hills per acre. Where melons are planted in continuous parallel rows, the rows are spaced 14 to 20 feet apart.

Hills should always be lined up in both directions, in order that the crop may be cultivated both ways during the early part of the season.

The customary method of planting watermelons, in all localities, begins with harrowing the ground and then marking it off in both directions. Where manure is worked into the hills the planter usually scatters the seed slightly and pushes them into the soil with a finger to a depth of ½ to 1 inch. Where no manure is used, often he plants the seed directly in the cross marks and covers them by hand or with a hoe. Three seed to a hill are sufficient; but usually six or seven are planted, to insure a good stand. Seed planted in a continuous row or drill is often put in by means of either a hand drill or a one-horse drill. Seeding with a drill commonly involves using larger quantities of seed than are required for hand planting.

Thinning of the plants should begin as soon as they come up. At first about three plants should be left in each hill. Later the number left should be not more than two or, in most cases, one per hill. Row plantings should be thinned to a single plant every 6 to 8 feet.

The best yields of high-grade melons are obtained where hills are spaced at least 10 by 12 feet and the plants are thinned to 1 per hill. This spacing means about 360 hills per acre, and with 2 melons per hill the yield per acre is about 700 melons altogether or 450 to 500 marketable melons.

CULTIVATION

Cultivation of watermelon plants should begin within a few days after they come through the ground. Where the hills have been carefully checked the land can be cultivated for some time with a harrow or weeder, with a little hand work directly around the hills. Some growers cultivate along the rows with a one-horse or a two-horse cultivator and then work out the middles with a harrow. As a rule about three or four general cultivations are sufficient, but cultivating frequently early in the season not only keeps the soil in good condition but prevents growth of weeds. Later, when the vines begin to spread, it may not be possible to cultivate in both directions.

Training the vines in rather well defined rows makes it possible to continue cultivating in one direction until the melons are two-thirds grown. It should be borne in mind that the watermelon is a rather shallow-rooted plant and that the roots often spread out farther than the vines. For this reason the land must be worked shallowly, especially near the hills and after the vines begin to run freely.

PRUNING

Growers of high-grade watermelons have found it desirable to remove surplus young melons from the vines in order to get fruits

of shipping size, all of normal shape. The word "pruning," as used in connection with melon growing, means removing misshapen melons and otherwise reducing the number on each vine, not cutting back the vines. Any cutting back of the vines would interfere with the development of the melons. Usually the grower waits until there is a good set of melons on the vines, the largest being about 4 inches long, and then removes all but two of the best melons from each hill or each vine.

Sometimes three or four melons are left at the first pruning and the two best ones are left at a second pruning, about a week after the first. Some of the smaller varieties are not pruned so closely, four to six melons being left on each vine. Pruning twice may not pay, for as a rule all the work can be done satisfactorily at one time. Pruning should be done only when the vines are dry, so as to avoid spreading anthracnose.

In order to avoid stooping, some growers use a long-handled knife or cutter to snip off the undesired melons. Others use an ordinary penknife, because they think the person doing the pruning should examine the melons more carefully than he can without stooping. A cutter can easily be made by sawing a slit in one end of a broomstick, inserting a thin piece of steel, fastening the steel with rivets or screws, and sharpening its outer edge. In pruning with a cutter, the operator places the blade on the stem that attaches the melon to the vine and with a slight downward thrust severs the stem close to the melon, taking care not to cut or injure the vine.

Pruning watermelons causes more of the nutrients taken up by the vine to go to the development of the melons that are left and usually results in production of a high percentage of marketable melons. Melons grown for home use are seldom pruned, as their size is not so important.

INSECT ENEMIES AND THEIR CONTROL[2]

Important insect enemies of the watermelon include the striped, western striped, and spotted cucumber beetles and the melon aphid.[3] Cutworms and wireworms have been known to cause severe injury at times.

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[2] This section was prepared by Horatio C. Mason, entomologist, Division of Truck Crop and Garden Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration. For additional information regarding insects attacking watermelons and related plants, communicate directly with your State agricultural college or with the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington 25, D. C. If you do not recognize the insects causing injury, send specimens for identification, together with an explanatory letter, to your State agricultural college or to the Bureau of Entomology and Plant Quarantine. The specimens should be placed in a vial of preservative, such as formalin, and this should be wrapped carefully in a durable container to avoid breakage or loss in transit.

[3] The full names of the insects mentioned here are as follows:

Common name	*Scientific name*
Striped cucumber beetle	*Acalymma vittata* (F.)
Western striped cucumber beetle	*Acalymma trivittata* (Mann.)
Spotted cucumber beetle	*Diabrotica undecimpunctata howardi* Barber
Melon aphid	*Aphis gossypii* Glov.

All the insecticides mentioned here should be handled with care. Also, they should be kept out of reach of children and animals and away from food and feed.

CUCUMBER BEETLES

East of the Rocky Mountains the striped cucumber beetle is perhaps the most important insect enemy of the watermelon. This insect passes the winter in the adult (beetle) stage. In seasons when spring weather conditions are favorable for emergence from hibernation, it appears early enough to be present in large numbers at about the time the melon seedlings are pushing through the ground. Not only do the beetles destroy small watermelon seedlings but the larvae, or immature insects, sometimes cause severe damage to the roots of larger plants.

The grower must be on the alert in order to apply control measures when the beetles first appear. A delay of 24 hours may result in loss of an entire planting. The most critical period is between the time the seedlings come through the ground and the time the plants start to form vines.

Either dusts or sprays may be used for control of the striped cucumber beetle, but most growers find dusting of watermelons more practical than spraying. Dusts containing 0.75 to 1.0 percent of rotenone (a poison derived from powdered roots of the tropical plants derris and cube) or 40 to 50 percent of cryolite (sodium fluoaluminate) in a diluent such as talc or pyrophyllite are recommended in many sections of the country for control of this insect. A 10- to 15-percent calcium arsenate dust is used with success in many areas. If a spray is preferred, it is recommended that one of these three be used:

	Pounds per 100 gallons of water
1. Derris or cube root powder containing 5 percent of rotenone	3
2. Derris or cube root powder containing 4 percent of rotenone	4
3. Cryolite	5 or 6

Ordinarily these materials can be bought from local insecticide dealers.

The fungicides ordinarily applied to watermelons may be used together with rotenone dusts or sprays, but fungicides containing lime should not be used with cryolite.

Cryolite and calcium arsenate should not be applied to watermelons unless the residue can be removed from the fruits by washing or other means.

The western striped and spotted cucumber beetles are often serious pests of the watermelon in some localities. The insecticides just recommended for control of the striped cucumber beetle will normally give satisfactory control of these two insects.

Apply the insecticide directly to the plants as soon as the beetles appear and every few days thereafter as long as necessary. Provide a light, even coating of dust or spray over the entire plant, especially at the point where the stem emerges from the soil. The beetles often congregate and feed at this point and thus cause loss of the seedling crop. Apply the dusts at rates of 15 to 30 pounds

and the sprays at rates of 75 to 125 gallons per acre per application, the quantity depending upon the size of the plants. Better coverage will normally be obtained if the insecticide is applied when there is little air movement.

Do not overlook the need of sanitary measures. Destroying the old melon vines after the crop is harvested reduces the number of beetles that will develop and spread to other plantings, or go into hibernation in the autumn to begin a new infestation the following season.

MELON APHID

The melon aphid is a small louselike insect, which obtains its food by sucking plant juices. It feeds on the under side of the leaf, and its presence often is first shown by a slight curling or cupping of leaves. An infestation may start from a small number of winged females that fly to a melon field from any one of several food plants. These females start new colonies and, unless checked, the aphids spread over entire plants and in time may infest an entire field. In heavy infestations the leaves curl and then lose color, and the affected plants die.

A watermelon planting should be examined frequently for aphids, so that any infestation will be detected early and insecticides may be applied before it becomes widespread. The insect is hard to control at times and, once established in a planting, may destroy the crop. Some growers examine their plantings daily, and when they find infested plants either thoroughly treat them with insecticide or destroy them by covering them with soil.

Dusts or sprays containing nicotine are recommended for control of the melon aphid. Most growers prefer dusting to spraying, especially when the foliage is heavy. A dust should contain from 3 to 4 percent of nicotine in hydrated lime. It can be mixed at home in a can or drum with a tight-fitting lid. Fill the container about half full of lime, add several stones about the size of a hen's egg, pour in about 1¼ fluid ounces of nicotine sulfate (40 percent) for each pound of lime, replace the lid, and roll or shake the container for several minutes. After standing a few minutes the dust is ready for use. For best results, the mixture should be used while it is fresh.

If a spray is preferred, mix 1½ pints of nicotine sulfate (40 percent) and about 4 pounds of soap in 50 gallons of water, or mix small quantities in the proportions of 1 tablespoonful of nicotine sulfate and 2 level tablespoonfuls of soap flakes to 1 gallon of water. If the spray forms drops and does not spread over the leaves, add more soap.

Apply the dust or spray to the under sides of the leaves, so that it will hit the aphids. An angle nozzle on the duster or sprayer aids greatly in doing this. Best results are obtained when the foliage is dry, when there is little air movement, and when the air temperature is 70° F. or above. Beginning as soon as you see the aphids, make two or three applications at 4- or 5-day intervals to prevent the aphid infestation from building up. Apply the dust at the rate of 15 to 35 pounds per acre application and the spray at 75 to 125 gallons per acre application, the amount depending upon the growth stage of the crop. As nicotine dust deteriorates

rather rapidly upon exposure to air, it should be kept in an air-tight container. Any portion remaining unused in the duster should be transferred to a screw-top or friction-top can.

When working with nicotine sprays or dusts, avoid inhaling the nicotine fumes.

The fungicides ordinarily applied to watermelons may be used together with nicotine dusts or sprays.

CUTWORMS

Cutworms sometimes cause serious damage to a watermelon crop by cutting off young plants at the surface of the ground. Poisoned bait is an effective remedy for these pests. It can be prepared by mixing thoroughly 1 pound of paris green, white arsenic, sodium fluosilicate, or sodium fluoride with 20 to 25 pounds of dry bran and then adding 15 to 20 quarts of water, enough to make the mixture a crumbly mass. For small quantities the proportions are ¼ pound of the insecticide, 5 pounds of dry bran, and 3 to 4 quarts of water.

Cutworms move around and feed mostly at night. The bait should therefore be mixed in the afternoon and applied late in the evening, while it is still fresh, moist, and attractive to the cutworms. If the presence of cutworms in a watermelon field is suspected before the plants come up, the bait should be broadcast thinly over the entire field. If the plants are above ground, the bait should be scattered thinly on the ground around the plant hills. From 10 to 15 pounds of the wet bait per acre is enough for one application. Two or three applications at 2-day intervals may be required.

Melons are much more likely to be damaged by cutworms if planted on land that was in a sod crop the previous season.

In the home garden, cutworms can be trapped by placing small boards and chips on the ground near the plants. The cutworms will gather under the boards and chips, where they can be collected and destroyed.

WIREWORMS

Good results in controlling wireworms in watermelon plantings have been reported from use of a dilute solution of dichloroethyl ether. The solution is prepared by adding 17 fluid ounces of dichloroethyl ether to 100 gallons of water. When applied at the rate of 1 quart per hill, this solution is repellent to wireworms and is safe for germinating seeds.

For information concerning the control of wireworms before the crop has been planted, consult Department of Agriculture Farmers' Bulletin 1866, Wireworms and Their Control on Irrigated Lands, or Bureau of Entomology and Plant Quarantine Circular EC–6, Control of Wireworms in Irrigated Lands with Ethylene Dibromide.

DUSTING EQUIPMENT

A small hand duster of the plunger type may be used by the home gardener in applying dusts for the control of melon pests. For larger plantings, a knapsack duster of the bellows type is more

satisfactory. Power equipment may be desirable for dusting large commercial plantings. Regardless of the type of duster used, the nozzle or nozzles should be so held or adjusted as to permit the dust to spread before it hits the plants.

DISEASES AND THEIR CONTROL

Watermelons are generally subject to certain diseases that often destroy much of the crop. A grower who uses the right control measures, however, can prevent or greatly reduce losses from disease. The most important watermelon diseases are fusarium wilt, anthracnose, downy mildew, stem-end rot, and root knot.

The chemicals recommended here for use in disease control are injurious to man and animals if taken internally; some of them are extremely poisonous. Anyone handling them should take care to keep them from getting into his mouth, eyes, or nose. When chemicals are used in dust form, care should be taken not to inhale them or to get large quantities on the hands or arms. Anyone using dusts on plants in the field should wear a respirator or dust mask. When a chemical solution has been applied as a spray, any part of it remaining unused should be poured out in such a way that it will sink into the ground and not stand in puddles. After a spray solution is applied, vessels used in preparing it should be cleaned thoroughly and clothing and hands should be washed. All the chemicals should be kept under lock and key or, at least, out of reach of children and animals.

FUSARIUM WILT

Fusarium wilt of watermelons occurs very commonly in most sections where the crop is grown on a commercial scale. This disease is caused by the fungus *Fusarium oxysporum* f. *niveum* (E. F. Sm.) Snyder & Hansen, which enters the plant through the roots and then gets into the water-conducting vessels of the stem. Wilt is usually most severe on light sandy soils. Where the soil is heavily infested with the fungus, an entire crop is likely to be lost. Temperatures of 75° to 80° F. are most favorable to development of the fungus.

In sections where wilt often occurs melons are rarely planted for 2 successive years in the same field, because of danger that the fungus will increase rapidly in the soil and cause loss of the crop. The fungus can be spread from field to field in soil carried on farm tools or the feet of farm animals, or in drainage water. Also, its spores can be carried by wind. It can live in soil for 10 to 15 years even when melons are not being grown. The form of this fungus that attacks watermelons apparently does not attack related crops such as muskmelons, cucumbers, or squash.

Watermelon plants may be affected by the *Fusarium* fungus at any stage of growth. If a young seedling becomes infected its seed leaves droop, it wilts, and within 1 or 2 days it dies. If a plant that has put out young runners becomes infected the entire vine may suddenly wilt and die, or at first there may be wilting only during the day and some recovery at night. Older plants may

become completely wilted within a short time (fig. 5) or may first appear stunted and later show symptoms of wilt. Sometimes one runner of an infected plant wilts before the rest of the plant shows any outward sign of disease. If the stem of the plant is cut lengthwise near the ground line its woody portion is found to show a characteristic brown discoloration, sometimes almost black. In late stages of the disease a white growth of the fungus may appear on the surface of the stem near the ground line.

Since the wilt fungus enters the plant through the roots, spraying or dusting is of no value in controlling it. Crop rotation is an important means of control. Because the fungus can live 10 to 15 years in the soil, rotation alone does not offer assurance of freedom from the disease. However, after 8 to 10 years melons can be planted again without much danger of severe injury. The best way to avoid loss from wilt is to use varieties that are sufficiently wilt-resistant to produce satisfactory crops on infested soil. A number of such varieties have been developed, including types suited to nearly all sections where watermelons are grown.

The Florida Agricultural Experiment Station has developed the wilt-resistant varieties Leesburg and Blacklee. The Australian Department of Agriculture has developed the wilt-resistant variety Hawkesbury, which is adapted to the southern and some of the central United States. The Iowa Agricultural Experiment Station has produced a number of resistant varieties suited to conditions in the Middle West, of which the two in most general use are Improved Kleckley Sweet No. 6 and Stone Mountain No. 5. For use under western conditions, the California Agricultural Experiment Station has produced the resistant varieties Klondike R–7 and Blue Ribbon. The Georgia Agricultural Experiment Station has developed Georgia Wilt-resistant. The Tennessee Agricultural

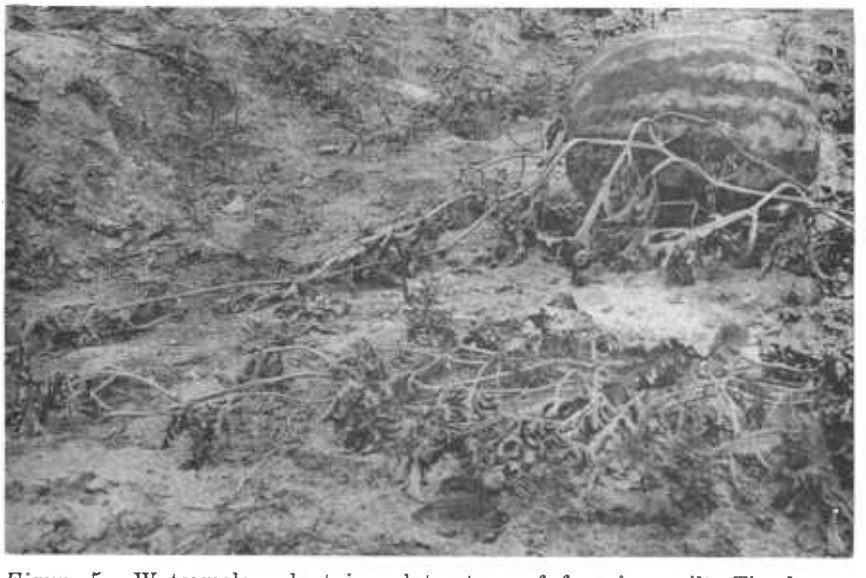

Figure 5.—Watermelon plant in a late stage of fusarium wilt. The leaves have wilted and are about to wither and die.

Experiment Station has developed Miles, a wilt-resistant variety the fruit of which is moderately large and has a bright-green rind striped with darker green. Wilt-resistant strains of Dixie Queen have recently been produced, one of which is called Missouri Queen. Some of these wilt-resistant varieties are described in this bulletin under the heading "Desirable Varieties."

ANTHRACNOSE

Anthracnose is perhaps the most destructive disease of watermelons. It occurs in nearly all sections where the crop is grown and causes serious losses also on muskmelons and cucumbers.

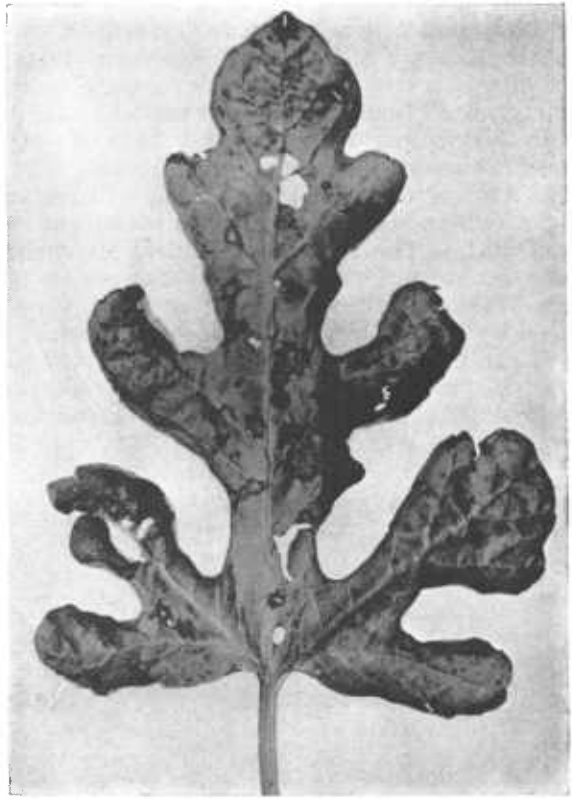

Figure 6.—Watermelon leaf showing dark, irregular spots caused by the anthracnose fungus.

This disease is caused by the fungus *Colletotrichum lagenarium* (Pass.) Ells. & Hals., which attacks watermelon leaves, stems, and fruits. It is most severe at times of warm, rainy weather and is especially serious in the Southern States.

The first symptom of anthracnose on watermelons is small, irregular black spots on the older leaves (fig. 6). These spots gradually enlarge. If they are numerous, the leaf finally shrivels

and dies. When the weather favors rapid spread of the disease a watermelon field may show so many blackened leaves that it looks as though burned. Under such conditions many fruits fail to ripen and many are likely to be sunburned. Under conditions less favorable to anthracnose the older leaves are severly damaged and the runners are left bare near the center of the hill. Stems and runners of infected plants show long, narrow tan or black spots. Some of the runners are girdled by such spots and killed.

On the fruits the first symptom of the disease is small raised spots with a dark, water-soaked appearance. The centers of the spots become sunken and turn yellow (fig. 7). In moist weather the centers of the spots on fruit may be covered by pinkish masses of spores of the fungus. Less often, such spore masses appear on the spots on stems and leaves. The spots on the fruit slowly enlarge, sometimes to a diameter of an inch, and their centers become black and may crack open. Many infected fruits become worthless in the field. If fruits showing the small raised spots of the early stage of the disease are shipped, they are likely to decay in transit both because of growth of the anthracnose fungus and because other decay-producing organisms enter them through these spots. Frequently, infection that was not evident at the time of harvest causes melons to become spotted during shipment.

The anthracnose fungus can live for at least 1 year on decaying plant refuse in the soil. Also, it is carried on seed. When the fungus has once gotten a start in a field its spores can be spread by wind, by raindrops splashing from leaf to leaf, or by drainage water flowing from one part of the field to another. If diseased vines are cultivated and handled when wet with rain or dew the spores can be carried to healthy plants on field workers' hands or clothing or on farm implements. Because of this the disease often spreads rapidly in a field after the first picking. In warm, wet weather fully developed spots may appear on leaves within 7 days after the fungus spores germinate; under such conditions the disease may appear throughout a field within a very short time.

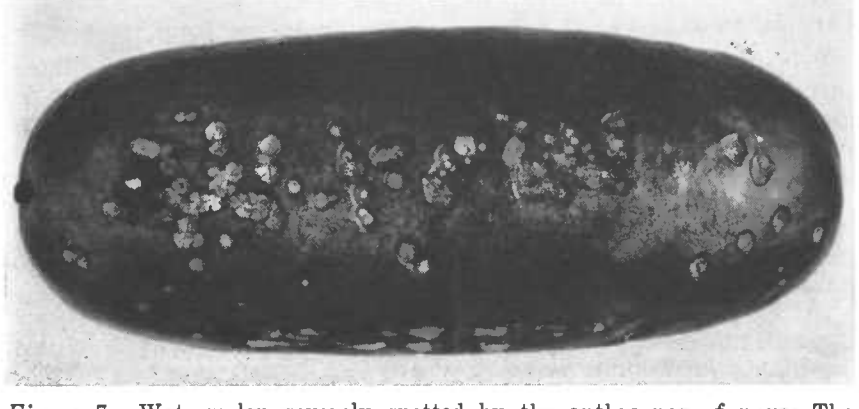

Figure 7.—Watermelon severely spotted by the anthracnose fungus. The circular spots are slightly raised and have light-colored depressions in their centers, which often are covered with pinkish masses of the fungus spores.

The principal means of controlling anthracnose of watermelon are (1) rotating the crop, (2) treating the seed with chemicals, and (3) spraying or dusting the plants.

Crop rotation is important particularly because the fungus can live from one season to the next. Watermelons should not be planted on land where cucumbers or muskmelons have been grown the previous season, since these crops also are subject to anthracnose. It is best not to plant any of these crops on the same field oftener than once in 5 or 6 years.

Seed is a common source of the first anthracnose infection in a field, because spores of the fungus from infected melons are likely to lodge on the surfaces of seed that are being harvested. It is extremely important, therefore, that all watermelon seed be given chemical treatment before it is planted. Seed can be treated by soaking for 5 minutes in a 1–1,000 solution of bichloride of mercury (corrosive sublimate). This solution can be prepared in small quantities by using the blue tablets sold by druggists. Dissolving one of the tablets in a pint of water gives a 1–1,000 solution. Large amounts of solution are prepared by dissolving 1 ounce of the chemical in 7½ gallons of hot water. In preparing the solution, glass, earthenware, enamel, or wooden vessels must be used, since bichloride of mercury corrodes metal containers. The solution must be cooled before it is used.

Seed to be treated is poured into a loosely woven bag until the bag is not more than half full. The seed is then immersed in the solution for exactly 5 minutes. It should be well stirred in the solution to insure complete wetting. After 5 minutes in the solution the seed is removed and washed for 15 minutes in running water or in several changes of water. After being washed it is at once spread in a thin layer to dry. The same lot of solution must never be used for more than two lots of seed, and at least 1 quart of solution must be used to each pound of seed. If old bags are to be used in storing treated seed they should be dipped in the bichloride of mercury solution and then washed.

Remember that bichloride of mercury is very poisonous. See the warning on page 14.

Proper use of sprays and dusts can greatly reduce losses from anthracnose. The applications probably should begin as soon as the vines have formed runners and continue at 7- to 10-day intervals, depending on the weather. If the weather is dry during the early part of the growing season and no disease appears, it may be safe to delay using a fungicide until midseason; but the field must be closely watched for appearance of the disease, and it must be kept in mind that under favorable conditions the anthracnose fungus can spread very rapidly when it once gets a start.

In the past, bordeaux mixture was commonly used for control of anthracnose on watermelon; now it has been found to injure the plants, especially when they are small, and is not generally recommended. The compounds known as fixed or neutral coppers are considerably less injurious to the plants and about equal to bordeaux mixture in effectiveness. They, also, cause some injury to foliage. They can be applied as sprays or as dusts. In recent

years certain organic fungicides (dithiocarbamates)[4] have proved very effective against anthracnose on watermelon. They cause less injury to watermelon plants, particularly small ones, than many other fungicides. Zineb and nabam (the latter used with zinc sulfate and lime) have given good results in control of this disease, especially in the Southeastern States, where they are widely used. Ziram, also, has proved effective. The related compound ferbam gives good results, but it is somewhat more likely than ziram to injure young plants.

Methods of applying the fungicides mentioned here are discussed later under the heading "Spraying and Dusting."

A new watermelon variety, Congo, developed at the United States Department of Agriculture's Regional Vegetable Breeding Laboratory, Charleston, S. C., has proved somewhat resistant to anthracnose. Even with this variety fungicides must be used to obtain good control of anthracnose, but Congo's resistance makes it much easier to prevent losses from the disease.

DOWNY MILDEW

Downy mildew is not so generally destructive to watermelon as anthracnose or fusarium wilt, but it often causes heavy losses in the South Atlantic and South Central States. This disease is caused by the fungus *Pseudoperonospora cubensis* (Berk. & Curt.) Rostow., which also attacks muskmelons, cucumbers, squash, and pumpkins. The fungus attacks only the leaves of the plant. The disease usually does not become severe until midseason.

The first symptom of downy mildew is yellowish spots on the leaves. At first these spots are roughly circular and do not have clear-cut margins. Later they turn dark and become irregular in shape. The spots may be few or so numerous that they cause the leaf to shrivel and die. The fungus soon produces spores on the under sides of the leaves, and these are carried by wind and washed or splashed by rain to other plants. When spores lodge on a leaf they can cause new infections, which result in visible spots within a few days.

The fungus causing downy mildew apparently does not live in the soil and is not carried on seed. However, in Florida it is present on some of its host plants throughout the year, and because the

[4] Certain organic fungicides are referred to in this bulletin by recently coined common names. These common names and the chemical names of the substances are as follows:

Common name	*Chemical name*
Ferbam	Ferric dimethyl dithiocarbamate
Ziram	Zinc dimethyl dithiocarbamate
Nabam	Disodium ethylene bisdithiocarbamate
Zineb	Zinc ethylene bisdithiocarbamate

These chemicals are marketed under various trade names such as Fermate, Karbam-Black, and Ferradow for products containing ferbam; Zerlate and Karbam-White for those containing ziram; Dithane D–14 and Liquid Parzate for those containing nabam; and Dithane Z–78 and Parzate for those containing zineb. (Use of trade names in this publication is solely for the purpose of providing specific information. It does not constitute a guarantee or warranty of the products named and does not signify that these products are approved to the exclusion of others of suitable composition.)

spores are readily carried by wind the disease gradually spreads northward during the spring and summer. Downy mildew is more likely to be serious on watermelons that are planted near cucumbers or muskmelons, because these crops are highly susceptible to it and great numbers of spores are rapidly produced on them.

The fungicides recommended for control of anthracnose are effective also against downy mildew. The same schedule of applications can be used for both diseases.

Methods of applying fungicides for control of downy mildew are discussed later under the heading "Spraying and Dusting."

STEM-END ROT

Stem-end rot of watermelons can cause heavy losses in transit. It occurs in the field, but most of the infection takes place after harvest and the rot develops chiefly during shipment. This disease is most serious in melons produced in the Southern States, partly because of the long time required to transport them to northern markets.

Stem-end rot of watermelons is caused by the fungus *Physalospora rhodina* (Berk. & Curt.) Cke. This fungus also attacks citrus, sweetpotatoes, corn, and cotton. Diseased plants of these crops may be a source of infection for melons in the field. An uninjured melon on the vine is not susceptible to stem-end rot. When its stem is cut or its rind is broken a small amount of sap collects on the injured surface. The sap-covered injured surface is a favorable place for the germination of spores and for entry of the fungus into the melon. Therefore, the percentage of a carload of melons that will decay in transit increases with the length of time the melons are exposed to infection after they are cut from the vine. In the car the fungus can spread from any decaying melon to healthy ones through untreated cut stems or injuries caused by careless handling in loading. Lack of ventilation, too much moisture, and high temperatures favor rapid development of the fungus in watermelons during shipment.

The first symptoms of rot if infection occurs in the stem are browning and shriveling of the stem. An affected stem feels soft and hollow when pressed. Next decay of the fruit begins at the point of attachment to the stem, and a water-soaked appearance develops there. There is a distinct line between the sound and the decayed part of the fruit. The decay advances rather rapidly, the flesh becoming soft, water-soaked, and slimy. By the time one-third of the fruit has decayed the stem end has turned dark and shriveled (fig. 8). Frequently the rind becomes covered with a dark-gray growth of the fungus and great numbers of spores are produced on the older decayed areas. The same type of decay may occur at any point where the melon is bruised or wounded.

Protecting watermelons from infection with stem-end rot calls for careful harvesting, for prompt removal from the field to the loading point, and for treating the stem ends while the melons are being packed for shipment. To avoid getting the fungus on their hands and knives, and thus spreading it as they work, those cutting the melons from the vines should never cut or touch a de-

cayed fruit. The sound fruits should be clipped with the longest possible stems.

Fruits should be handled carefully when they are being loaded in the field and packed in the car, in order to prevent injury to the rind. As soon as a tier of melons has been placed in the car, each stem should be cut down to about 1 inch, with a sharp knife. The cut should be clean and smooth. The freshly cut end of each stem should immediately be treated with a paste containing copper sulfate in order to prevent infection. The paste is applied with a small brush (fig. 9). After loading a tier it is best to go to the other end of the car to load the next. Then the stems of one tier can be clipped and treated as the next tier is being loaded. Melons should never be left in a car for any length of time without treatment.

See the warning on page 14 before using a copper sulfate paste.

To prepare a paste for treating stem ends, place 3½ quarts of water in an enameled kettle, add 8 ounces of copper sulfate (bluestone), and place over flame. While this solution is coming to a boil, mix 8 ounces of laundry starch with 1 pint of cold water and stir until the lumps disappear. As soon as the bluestone solution boils, begin slowly pouring the starch into it, stirring constantly to avoid lumps. Continue stirring the mixture until the starch thickens evenly. This usually takes only 2 to 3 minutes. The paste can conveniently be kept in 1-quart glass fruit jars with glass tops. It is most satisfactory when used fresh. Commercially pre-

Figure 8.—Portion of watermelon fruit showing shriveling and decay caused by stem-end rot.

pared copper sulfate paste for treating watermelons is available in most localities where it is needed.

Figure 9.—Treating freshly clipped watermelon stems to prevent stem-end rot in transit.

SPRAYING AND DUSTING

Watermelon losses from anthracnose and downy mildew can be greatly reduced by efficient use of the right fungicides. It must be kept in mind, however, that fungicides can only protect plants from infection; they cannot cure plants that have become infected. These diseases can be controlled satisfactorily only if an effective fungicide is applied in such a way as to cover the foliage thoroughly, and only if this is done before the disease organism becomes well established in the field.

Before using chemicals for spraying or dusting, see the warning on page 14.

Methods

Nearly all the fungicides generally used on watermelons can be applied either as sprays or as dusts. Sprays are somewhat more effective than dusts in protecting the plant from infection, because

they stick to the foliage better. They are considerably harder to apply, however, and where a large acreage of melons must be treated dusts are very commonly used. Good results can be had from dusts if they are applied with a good power duster the outlets of which are properly adjusted for complete, even coverage of the row. A skilled operator can obtain good coverage by dusting from an airplane. The amount of dust used ranges from 25 to 50 pounds per acre, depending on the size of the plants and the method of application. Dusts should be put on early in the day when the air is fairly still and, preferably, when the plants are wet with dew.

Good coverage can be obtained by using a power sprayer that carries two lengths of hose. With such apparatus each operator can cover two rows completely or in part, depending on the size of the plants. Each hose should be equipped with two nozzles where large vines are to be sprayed. The sprayer should be operated at a pressure of from 250 to 300 pounds, and 75 to 150 gallons of spray should be applied per acre, depending on the size of the plants.

Fixed Copper Sprays

The fixed, or neutral, copper compounds include among others tribasic copper sulfates, copper oxychloride, and copper oxychloride sulfate. These are generally proprietary compounds, sold under trade names. They are less injurious to plants than bordeaux mixture, and in recent years they have been widely used on melons and cucumbers.

In spraying watermelons the fixed copper compounds should be used on a basis that gives the equivalent of about 1½ pounds of copper (calculated as metallic copper) to 100 gallons of water. The copper content of each of these compounds is shown on the label, and the amount needed can easily be determined from this. For example, 3 pounds of a compound containing 50 percent copper gives 1½ pounds of copper, and a little less than 2 pounds of a compound containing 80 percent copper gives the same amount. No lime is used with fixed copper fungicides. Copper spray should not be used on very young plants, for it is likely to injure them. When small plants are to be sprayed it is best to choose one of the dithiocarbamate fungicides discussed below.

Fixed Copper Dusts

Fixed copper compounds are used as dusts and can be bought in this form from dealers in agricultural supplies. A dust containing about 5 percent actual copper is generally used for melons. Dusts can be prepared by mixing the necessary amounts of the copper compound with pyrophyllite, talc, or some other light, inert carrier. If a compound contains 50 percent copper, 10 pounds of it and 90 pounds of the carrier are mixed to obtain a 5-percent dust.

Bordeaux Mixture

Bordeaux mixture is an excellent fungicide, but it is no longer generally recommended for watermelons, because it is likely to cause some injury to the plants. If it is used, it should not be applied when the plants are very small. A 6–6–100 bordeaux mix-

ture, which contains 6 pounds of copper sulfate (bluestone) and 6 pounds of hydrated spray lime to 100 gallons of water, is preferable for watermelons. In preparing bordeaux mixture a finely powdered form of copper sulfate can be used that dissolves rapidly in water. This powder is placed on the screen of the spray tank and dissolved by running in enough water to fill two-thirds of the tank. The solution is then agitated while the lime, in a thin paste, is washed in with enough water to complete filling the tank.

Zineb

Zineb is an organic fungicide that has given effective control of downy mildew and has considerable value in checking anthracnose, although it seems somewhat more likely to injure the plants than ziram. For use as a spray, 2 pounds of the commercial product is dissolved in 100 gallons of water, without lime. In dusting, a mixture containing 6 to 8 percent of zineb is used.

Nabam

Nabam is used in liquid form. To make a spray, 2 quarts of the commercial product is added to 100 gallons of water. To this are added first 1 pound of zinc sulfate and then ½ pound of hydrated lime. The product thus prepared is closely related to zineb. Nabam combined with zinc sulfate and lime is effective against downy mildew and appears to be effective against anthracnose.

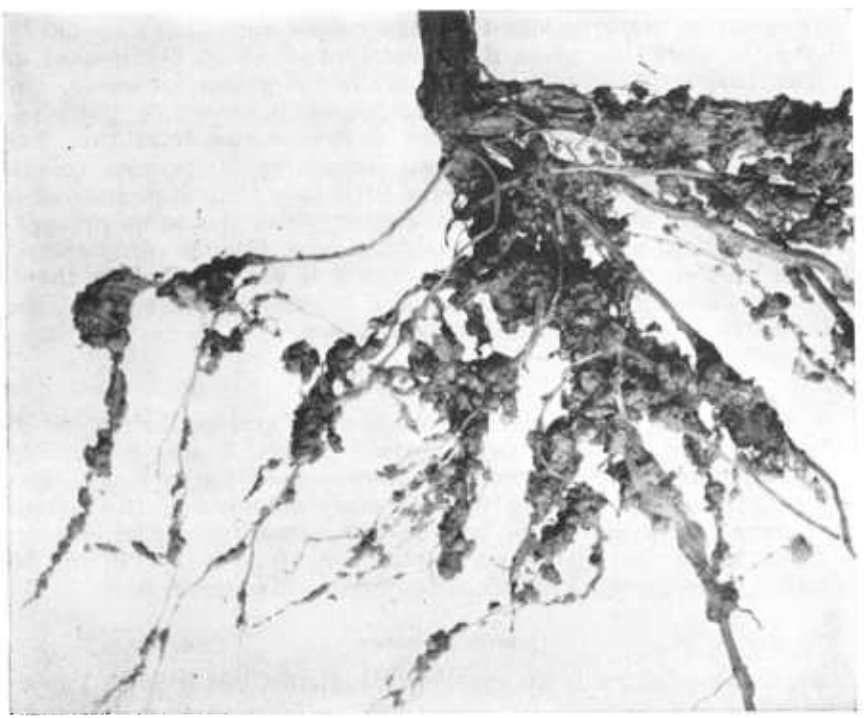

Figure 10.—Roots of young watermelon plant showing swellings, or galls, produced by root-knot nematodes.

Ziram

Ziram has given good results in control of anthracnose and downy mildew. It is less injurious to watermelon vines than the copper fungicides and is preferred to them for use on small plants. For use as a spray, the commercial product is dissolved in water at the rate of 2 pounds to 100 gallons. No lime is used. For use as a dust, it is mixed with talc, pyrophyllite, or some other light, inert carrier at the rate of 8 to 10 pounds of ziram to 90 pounds of the carrier.

Ferbam

Ferbam has proved effective in control of anthracnose but is somewhat more injurious to young plants than ziram. It is used as a spray at the rate of 2 pounds of the commercial product to 100 gallons of water and as a dust at the rate of 8 to 10 pounds of ferbam to 90 pounds of an inert carrier such as talc or pyrophyllite.

ROOT KNOT[5]

Root knot is caused by minute eelworms, or nematodes (*Meloidogyne* spp., formerly *Heterodera marioni*), which attack the roots of watermelon and other vegetables in many parts of the country, producing swellings, or galls, on the roots (fig. 10). Aboveground symptoms are lack of vigor, even dwarfing of the plants, and wilting during the hot period of the day. This trouble is often very serious in the sandy soils of the South. Whenever possible, the watermelon grower should use land that is free of root knot nematodes. As a measure for cleaning nematode-infested land to such an extent that it can produce watermelons profitably, it is recommended that one or more of the following crops be grown on it 2 out of 3 or 3 out of 4 years in rotation with the watermelons: Small grains, hairy indigo, various crotalarias, and (in some localities) peanuts.

Root knot nematodes can be controlled successfully by fumigating the soil. The fumigants most commonly used are mixtures containing dichloropropene (such as D–D, Dowfume N, and Nemafume) and mixtures containing ethylene dibromide (such as Dowfume W–40, Soilfume 60–40, Iscobrome D–42, Bromofume 40, and Iscobrome D). Small quantities of a fumigant are injected into the soil at closely spaced points to a depth of about 6 inches, or a very small continuous stream of the fumigant is played along a furrow at a depth of about 6 inches. A whole field may be fumigated, or the chemical may be applied only in rows or hills where seed is to be planted. For watermelons and other crops that are grown in widely spaced rows or hills, application in the row or in the hill has usually given satisfactory control of root knot at substantially less cost than treating the entire area. The various methods may be described as follows:

1. Entire-area fumigating, large-scale, is usually done with power-driven applicators that apply from 6 to 10 parallel streams at the same time. The chisels or other devices that deliver the fumigant into the soil should be spaced 12 inches apart.

[5] This section was prepared by J. R. Christie, senior nematologist, and Edna M. Buhrer, associate nematologist, Division of Nematology, Bureau of Plant Industry, Soils, and Agricultural Engineering.

2. Entire-area fumigating, small-scale, can be done with hand applicators. The rows of injection points should be 12 inches apart and the injection points should be 12 inches apart in the row. It is important that spacing be fairly accurate. The best way to make it so is to mark the field into 12-inch squares and inject the chemical checkerboard fashion—that is, at the crossmarks in even rows and halfway between the crossmarks in odd rows.

3. In-the-row fumigating, large-scale, is usually done with power applicators equipped to deliver a very small stream of the fumigant in the row where seed is to be planted.

Recently, some growers have been using power applicators that deliver a slightly smaller stream of the fumigant on *each side* of a row where seed is to be planted. The chisels through which the fumigant is fed are spaced 12 inches apart. This method is giving better control than the single-stream method of in-the-row fumigation. Tests are being made to find whether the advantage in results justifies the additional expense.

4. In-the-row fumigating, small-scale, can be done with hand applicators. A single row of injections 12 inches apart is made along each planting row.

5. In-the-hill fumigating is done with hand applicators. The position of each hill is determined and marked, and a single injection is made at each such point.

Soil is prepared for fumigation in the same manner as for seeding. The prepared soil should be moderately loose and reasonably free from clods, lumps, and undecomposed weeds or crop residues, and should have a fairly smooth surface. Roots from the preceding crop should have had time to decay. The temperature of the soil should be 60° F. or above. The soil should be fairly moist at a level close to the surface, for fumigants do not give satisfactory results when applied to dry soil. In other words, the soil should be just moist enough to permit planted seed to germinate easily.

Recommendations as to the quantities of chemicals used in fumigation by the various methods are as follows:

1. In entire-area fumigation: *a*. For a dichloropropene mixture, adjust power applicators to deliver about 25 gallons per acre and hand applicators to deliver about 2.5 cubic centimeters per injection. *b*. For an ethylene dibromide mixture, adjust power applicators to deliver about 15 gallons per acre and hand applicators to deliver about 1.5 cubic centimeters per injection.

2. In in-the-row fumigation, one stream per row: *a*. For a dichloropropene mixture, adjust power applicators to deliver about 3 cubic centimeters per linear foot of row and hand applicators to deliver about 3 cubic centimeters per injection. At these rates 1 gallon will treat about 1,300 feet of row. *b*. For an ethylene dibromide mixture, adjust power applicators to deliver about 2 cubic centimeters per linear foot of row and hand applicators to deliver about 2 cubic centimeters per injection. At these rates 1 gallon will treat about 1,900 feet of row.

In in-the-row fumigation, one stream on each side of a row: *a*. For a dichloropropene mixture, adjust the two shanks of the power applicator to deliver a total of 4.5 cubic centimeters (that is, 2.25

cubic centimeters per shank) per linear foot. *b*. For an ethylene dibromide mixture, adjust the two shanks of the power applicator to deliver a total of 3 cubic centimeters (that is, 1.5 cubic centimeters per shank) per linear foot.

3. In in-the-hill fumigation: For either a dichloropropene or an ethylene dibromide mixture, adjust hand applicators to deliver about 3 cubic centimeters per injection.

The rates suggested above for ethylene dibromide apply to mixtures containing about 40 percent of this chemical by weight (such as Dowfume W–40, Soilfume 60–40, Iscobrome D–42, and Bromofume 40). For mixtures containing lesser amounts of ethylene dibromide the rates should be increased proportionately; for example, for mixtures containing 20 percent ethylene dibromide by weight, such as Iscobrome D, the above rates should be doubled.

Holes or furrows left by the applicator should be filled promptly and firmly—merely knocking a little loose dry soil into them is not sufficient—and the soil surface should be left smooth and compact. When power equipment is used the soil surface can usually be smoothed satisfactorily with a drag attached behind the applicator. When it is necessary to drag or roll an area as a separate operation, this should be done promptly.

The time that must elapse between applying the fumigant and planting the seed varies greatly, depending on the fumigant used, the rate of application, and the moisture content and temperature of the soil. If fumigants are applied at the rates recommended, the temperature of the soil is not below 70° F., and the moisture content of the soil is only moderate, the following intervals should be sufficient: For dichloropropene mixtures, 18 days; for ethylene dibromide mixtures, 10 to 14 days. The drier the soil and the higher its temperature, the quicker the gases escape. Fumigants linger in cool, wet soil.

Where in-the-row or in-the-hill fumigation is practiced, care must be taken to plant the seed *exactly* along each treated row or near the center of each treated hill.

Several types of hand applicators are on the market. Large-scale operations requiring power-driven equipment often are carried out on a custom basis by individuals or companies engaging in the business of applying fumigants and owning the necessary equipment.

Anyone handling a soil fumigant should observe these precautions: Avoid prolonged breathing of the fumes. Never, under any circumstances, risk getting the liquid into the eyes or mouth. Do not allow the liquid to remain in contact with the skin; wash it off promptly with soap and water. If the liquid is spilled on shoes, gloves, or other clothing, remove the garments without delay.

GATHERING AND LOADING

Dealers and consumers have often complained of the quality of watermelons that have been shipped to market when still immature. Southern growers, in particular, should give more attention to the maturing of the melons they ship at the beginning of their season. The most practical field test now in use for

watermelon maturity is change in the color of the rind, especially on the part of the melon that is in contact with the ground. The background color of the rind on this part of the melon changes at the mature stage from white to pale yellow. The sugar content of the flesh and the firmness of the seed are better tests, but they cannot be determined in the field in a practical way.

Melons should be cut from the vine rather than pulled or broken off. The cutters can do their work conveniently either with ordinary penknives having rather slender blades about 2¼ inches long or with kitchen knives such as are used for peeling fruit. They should be careful to keep the stems as long as possible. As the melons are cut from the vines they are carried immediately to roadways or else turned over and left to be carried to roadways by "tote boys" who follow the cutters. Melons that have been cut from the vines should not be stood on end and should not be left long in direct sunlight.

In a field where the vines have been sprayed and roadways have been kept open, as is customary, every sixth row for passage of the sprayer, these same roadways serve for driving through the field to pick up the melon crop. If roadways have not been kept open for the sprayer, they should be prepared before melon harvest. This is done by dividing the field into sections of about 8 to 10 rows each and laying vines between rows aside so as to clear the necessary space between each two sections. As the melons are carried to the roadways they are placed in small piles. They should be laid down and piled carefully, so that their skins will not be injured and they will not be bruised. Watermelons should not be piled more than three high along driveways, and in no case should they be stood on either end.

Many different types of vehicle are used for hauling watermelons from the field to a railroad car or loading station, but in most sections farm tractor-trailers or trucks serve this purpose. In all cases it is desirable that a bed of straw or soft pine needles, about 5 inches deep, be placed in the bottom of the vehicle and that the sides and edges of the body be padded with burlap or canvas. Before the melon harvest begins, the trailer or truck body should be inspected carefully to see that no nails or sharp-cornered cleats are in position to injure the melons.

Usually watermelons that have been piled on the ground are handed by two men on the ground to two on the vehicle, one melon at a time. In no case should melons be loaded more than five deep, or stood on end. Laborers should never be allowed to walk on the load or ride on it. The most careful growers cover the load with canvas to protect the melons from the hot sun on the way to the transport trucks or railroad cars. Usually the melons are reloaded directly to transport trucks or to railroad cars. With a little extra care, transport trucks can be driven through the fields and one handling of the melons avoided.

All melons should be removed from the field the same day they are cut from the vines and preferably should be loaded onto railroad car or transport truck and forwarded that same day.

A railroad car or truck that is to be used in shipping watermelons should be thoroughly cleaned, and a strip of building

paper 3 feet wide should be stretched around the inside and fastened in place with tacks. This paper protects the melons from bruises, from chafing against the sides of the car, and from possible contact with injurious chemicals left on the car walls from some earlier shipment.[6] Before the car or truck is loaded, a bed of straw or pine needles about 3 inches deep is spread on the floor. To avoid losses in transit no wet bedding should be used—whether hay, straw, or pine needles. Especially in closed cars, the moisture given off by wet bedding causes a high humidity favorable to development of decay organisms. Where wet bedding is used the melons in the first layer are almost certain to decay on the side that rests on the bedding. A supply of thoroughly dry bedding material should be provided and stored in a shed or barn before the watermelon-shipping season opens.

How the melons should be arranged in the car depends upon their size and shape. Customarily, long-type melons are loaded four layers high if they weigh over 20 pounds and five layers high if they weigh less, and round-type melons are loaded three layers high if they weigh over 20 pounds and four layers high if they weigh less.

The melons should be placed in their proper positions in the car or truck as they are taken from the farm vehicle. They should not be piled at this time, because the extra piling would tend to cause bruising and increase the danger of losses in transit. As each tier of melons is placed in the car or truck their stems should be clipped and treated for prevention of stem-end rot. Melons that are brought to the car late in the evening should not be left without stem-end treatment overnight, as the spores of the rot fungus may develop during the night to such an extent that treatment applied the next morning cannot prevent rot.

SHIPPING AND GRADING

Watermelons are shipped by truck, in stock cars, in ventilated box cars, and sometimes, for long hauls, in refrigerator cars. Those grown in Florida and other South Atlantic States are shipped largely in ventilated box cars; those grown in Texas and southeast Missouri, in stock cars. Stock cars provide plenty of ventilation, but if they are to be used for watermelons they must be thoroughly cleaned and disinfected and must be stripped to prevent plugging or gouging of the melons.

Wholesale trading in watermelons is conducted largely on the basis of United States standards as amended in 1945. Copies of these standards can be obtained from the Production and Marketing Administration, United States Department of Agriculture, Washington 25, D. C.

A large percentage of the shipments of watermelons are inspected at shipping points and certified as to grade by licensed Federal-State inspectors. During the fiscal year 1947–48 a total of 17,375 carloads were so certified. Certificates issued show the melons' quality, condition, grade, and size. Federal inspection is available also in and near the larger market centers.

[6] For further information on such injury, see Department of Agriculture Circular 74, Chemical Injury to Watermelons in Transit.

General use of standards by growers and shippers has many advantages. As a basis for trading it tends to establish confidence among buyers and sellers, which helps to broaden the market. The standards serve as a common language between shipper and distant buyer and provide a basis for quoting prices that is generally understood throughout the industry. Inspection at shipping point under established standards tends to prevent unjustifiable rejections at destination in the case of sales made f.o.b., usual terms. Better production methods are encouraged by the use of standards, as melons of the higher grades usually sell at a premium over those of the lower grades or field-run melons.

YIELD

Yield of marketable watermelons usually averages about one carload to every 2½ acres. In many cases, owing to adverse weather conditions and other causes, the yield is as low as one carload to 5 acres. The more efficient growers harvest a carload from 2 acres.

Late in the season, when the marketable melons have practically matured, the vines sometimes set a second crop. This may be sold locally or used for hog feed.

FACTORS IN COST OF GROWING

Watermelon production costs vary considerably from one year to another and among different localities. The crop might be called a cheap one to produce, but the returns are often so small as to make reasonable profits very uncertain. If it were not for the fact that watermelons often serve as a catch or clean-up crop it is doubtful whether they would be grown to such an extent as at present.

In figuring how much it would cost him to produce a crop of watermelons the farmer should consider all these items: Interest on value of land or reasonable rental of land; cleaning and plowing land; fertilizers; seed; fitting land and planting; replanting; thinning; cultivating; spraying; thinning the melons; harvesting and loading; and stem-end treatment if necessary. To these he should add reasonable allowances for supervision and for wear on tools and equipment, and interest on any borrowed capital. He should credit the watermelon crop with the value of any improvement in land condition that can be expected to result from cultivating it.

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